Cache Mapping

- 1. Direct Mapping
- 2. Associative Mapping
- 3. Set- Associative Mapping

Direct Mapping

Main memory size = $128 B = 2^7$

Cache memory size = 32 B

Block size = 4 B

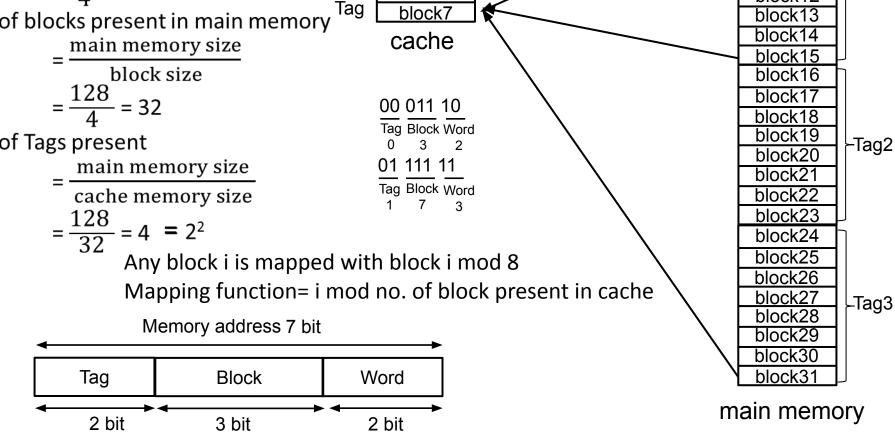
No. of words present in a block = 4

No. of blocks present in cache

cache memory size block size $=\frac{32}{4}=8=2^3$

No. of blocks present in main memory

No. of Tags present



block0

block1

block2

block3

block4

block5

block6

Tag

Tag

block0 block1

block2

block3

block4

block5

block6

block7

block8

block9

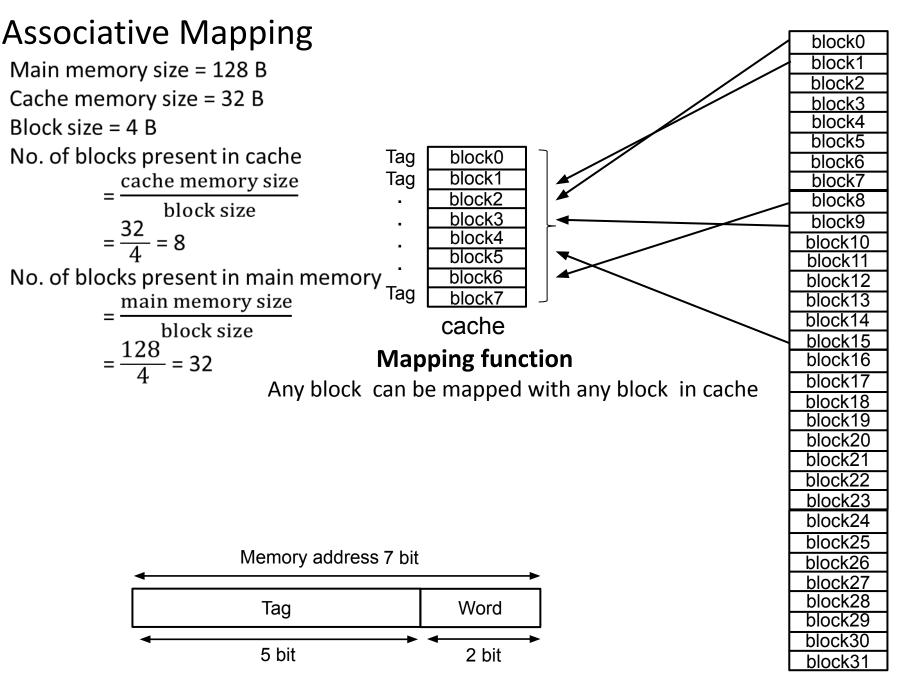
block10

block11

block12

∽Tag0

-Tag1



main memory

Set-Associative Mapping

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n way Set-Associative mapping
Where n=2^{x} and x=1,2,3....m
If x=1
then n=2 and it is 2 way Set-Associative mapping
If x=2
then n=4 and it is 4 way Set-Associative mapping
If x=3
then n=8 and it is 8 way Set-Associative mapping
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2 way Set-Associative Mapping block0 block1 Tag0 block2 Main memory size = 128 B block3 Cache memory size = 32 B block4 Block size = 4 Bblock5 Tag1 block6 No. of way =2Tag block0 block7 set0 block1 Tag No. of block present in cache=8 block8 block2 block9 set1 No. of set present in cache block3 Tag2 block₁₀ \equiv No. of blocks present in cache block4 block11 set2 block5 block12 block6 $=8/2=4=2^{2}$ block13 set3 Tag block7 Tag3 block14 cache block15 No. of Tags present block16 main memory size block17 cache memory size Tag4 block18 No of way block19 block20 **=** 128 X 2 block21 32 Tag5 block22 Any block i is mapped with block i mod 4 block23 $= 8 = 2^3$ block24 Mapping function i mod no. of set present in cache block25 Tag6 block26 block27 block28 Memory address 7 bit block29 Tag7 block30 Set Tag Word block31 main memory 2 bit 3 bit 2 bit

Direct Mapping

Assume a system has 2 KB cache, 64 KB main memory and 16 byte block.

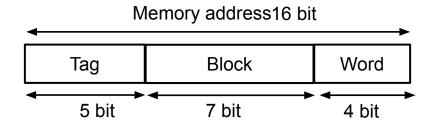
Number of blocks present in cache

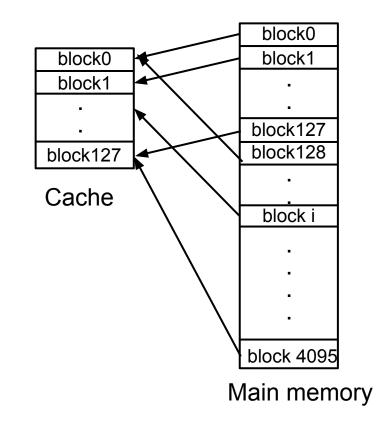
$$= \frac{\text{cache memory size}}{\text{block size}} = \frac{2 \times 2^{10}}{2^4}$$
$$= 2^7 = 128$$

Number of blocks present in main memory

$$= \frac{\text{main memory size}}{\text{block size}}$$
$$= \frac{2^6 \times 2^{10}}{2^4} = 2^{12} = 4096$$

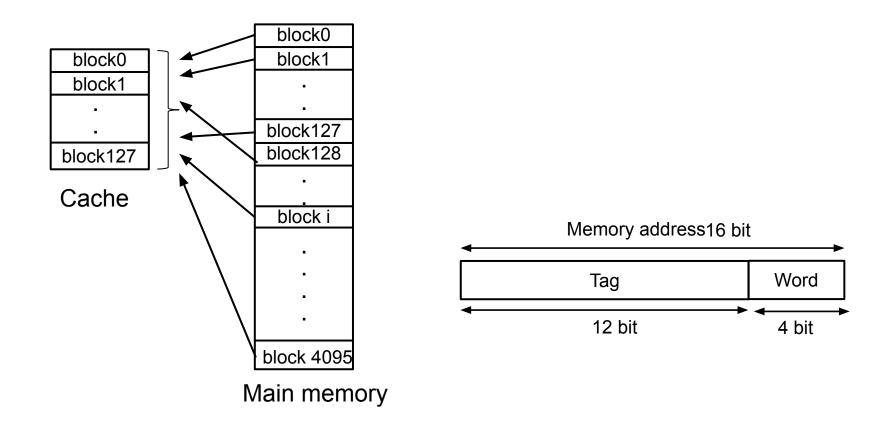
Number of tags =
$$\frac{\text{main memory size}}{\text{cache memory size}}$$
$$= \frac{2^6 \times 2^{10}}{2 \times 2^{10}} = 2^5 = 32$$





Advantage: Very simple and easy to manage. Search space is minimum compare to other mapping. **Disadvantage:** If a program requires block0 and block128 repeatedly then cache miss will occur due to block0 and block128 are mapped in the same place in cache.

Associative Mapping



Advantage: There is no limitation in block mapping.

Disadvantage: Search space is maximum compare to other mapping.

2 Way Set-Associative Mapping

Main memory size = 64 KB

Cache memory size = 2 KB

Block size =
$$16 B = 2^4$$

No. of way =2

No. of block present in cache=128

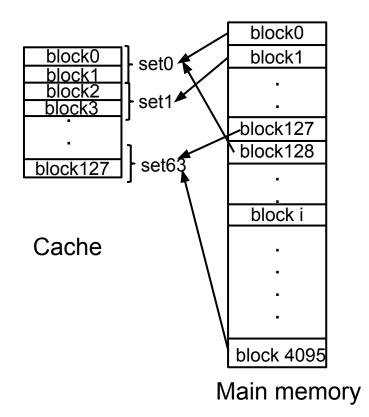
No. of set present in cache

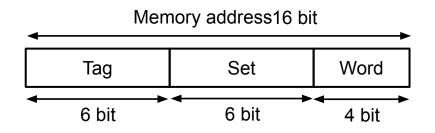
$$= \frac{\text{No. of blocks present in cache}}{\text{No of way}}$$
$$= 128/2 = 64 = 2^{6}$$

No. of Tags present

$$=\frac{2^6 \times 2^{10} \times 2}{2 \times 2^{10}}$$

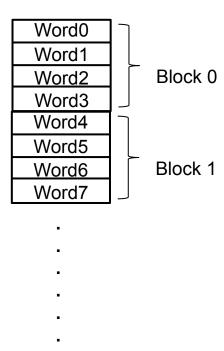
$$= 2^6$$





Thank You

Block size is 4 byte



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